Docket No. 884.535US1 Client Ref. No. P12099

CLEAN VERSION OF PENDING CLAIMS

ELECTRONIC ASSEMBLY WITH FILLED NO-FLOW UNDERFILL AND METHODS OF MANUFACTURE
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Serial No.: 10/003,238

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1. (Amended) A method comprising:

depositing an underfill material over a plurality of pads in a component-mounting area of a substrate, the underfill material comprising a filler material containing particles;

placing a component on the component-mounting area, such that terminals of the component are aligned with corresponding pads and substantially enveloped in the underfill material, the particles potentially inhibiting a suitable connection between corresponding terminals and pads unless the particles are substantially removed;

applying suitable pressure to cause the terminals to physically contact the pads and to substantially remove the particles from between corresponding terminals and pads; and

applying suitable heat to melt solder situated between the terminals and pads, which when cooled results in a suitable electrical and mechanical connection between corresponding terminals and pads.

3. (Amended) The method recited in claim 1, wherein, in depositing, the filler material is suitable to reduce the coefficient of thermal expansion.

4. (Amended) The method recited in claim 1, wherein, in depositing, the filler material is suitable to increase the modulus of elasticity.

5. (Amended) The method recited in claim 1, wherein, in depositing, the filler material is suitable to increase the viscosity.

6. (Amended) The method recited in claim 1, wherein, in depositing, the filler material is selected from the group consisting of silica, silicon oxide, silicon dioxide, silicon nitride, aluminum oxide, and aluminum nitride.

7. The method recited in claim 6, wherein, in depositing, the filler material is in the range of 0% to 80%, by weight, of the underfill material.

8. (Amended) The method recited in claim 1, wherein, in depositing, the particles have a size in the range of 0.05 microns to 40 microns.

9. (Amended) The method recited in claim 1, wherein, in depositing, the particles are substantially spherical.

10. (Amended) The method recited in claim 1, wherein, in depositing, the underfill material comprises a resin selected from the group consisting of an epoxy resin, a siloxirane resin, a superoxirane resin, a polybenzoxazine resin, a benzocyclobutane resin, or a mixture thereof.

11. The method recited in claim 1, wherein, in depositing, the underfill material comprises a fluxing agent.

12. (Amended) The method recited in claim 11, wherein, in depositing, the fluxing agent is selected from the group consisting of an organic carboxylic acid, a polymeric fluxing agent that has one or more carboxylic acid groups, an organic compound that contains one or more hydroxyl groups, or a mixture thereof.

13. The method recited in claim 1, wherein the pads are pre-coated with solder, and wherein, in applying suitable heat, the terminals become attached to the pads through the solder.

14. The method recited in claim 1, wherein the terminals are pre-coated with solder, and wherein, in applying suitable heat, the terminals become attached to the pads through the solder.

15. The method recited in claim 1, wherein the terminals and the pads are pre-coated with solder, and wherein, in applying suitable heat, the terminals become attached to the pads through the solder.

16. The method recited in claim 1, wherein the operations of applying suitable pressure and suitable heat are performed substantially concurrently.

17. (Amended) The method recited in claim 16, wherein the operations of applying suitable pressure and suitable heat are performed by one of a thermocompression bonder and an ultrasonic bonder.

18. The method recited in claim 1, wherein the operation of applying suitable pressure is performed by a die placement tool.

19. The method recited in claim 18, wherein the pads are pre-coated with solder, and wherein the method further comprises:

pre-attaching the terminals to the pads by applying suitable heat using the die placement tool.

20. The method recited in claim 18, wherein the terminals are pre-coated with solder, and wherein the method further comprises:

pre-attaching the terminals to the pads by applying suitable heat using the die placement tool.

21. The method recited in claim 18, wherein the operation of applying suitable heat is performed by solder reflow apparatus.

22. (Amended) A component package fabricated by:

depositing an underfill material over a plurality of pads in a component-mounting area of a substrate, the underfill material comprising a filler material containing particles;

placing a component on the component-mounting area, such that terminals of the component are aligned with corresponding pads and substantially enveloped in the underfill material, the particles potentially inhibiting a suitable connection between corresponding terminals and pads unless the particles are substantially removed; and

applying suitable pressure to cause the terminals to physically contact the pads and to remove substantially all potentially inhibiting particles from between corresponding terminals and pads.

23. (Amended) The component package recited in claim 35 and fabricated such that the operations of applying suitable pressure and suitable heat are performed substantially concurrently by apparatus from the group comprising a thermocompression bonder, an ultrasonic bonder, and a component placement tool.

24. (Amended) The component package recited in claim 35 and fabricated such that the pads are pre-coated with solder, and wherein, in applying suitable heat, the terminals become attached to the pads through the solder.

25. (Amended) The component package recited in claim 35 and fabricated such that the terminals are pre-coated with solder, and wherein, in applying suitable heat, the terminals become attached to the pads through the solder.

26. (Amended) The component package recited in claim 22, wherein the filler material is selected from the group consisting of silica, silicon oxide, silicon dioxide, silicon nitride, aluminum oxide, and aluminum nitride.

27. (Amended) An electronic assembly comprising at least one integrated circuit (IC) package fabricated by:

depositing an underfill material over a plurality of pads in an IC mounting area of a substrate, the underfill material comprising a filler material containing particles;

placing an IC on the IC mounting area, such that terminals of the IC are aligned with corresponding pads and substantially enveloped in the underfill material, the particles potentially inhibiting a suitable connection between corresponding terminals and pads unless the particles are substantially removed; and

applying suitable pressure to cause the terminals to physically contact the pads and to remove substantially all potentially inhibiting particles from between corresponding terminals and pads.

28. (Amended) The electronic assembly recited in claim 36 and fabricated such that the operations of applying suitable pressure and suitable heat are performed substantially concurrently by apparatus from the group comprising a thermocompression bonder, an ultrasonic bonder, and a component placement tool.

29. (Amended) The electronic assembly recited in claim 36, wherein the underfill material comprises a filler material selected from the group consisting of silica, silicon oxide, silicon dioxide, silicon nitride, aluminum oxide, and aluminum nitride.

33. The method recited in claim 1, wherein, in applying suitable heat, the underfill material is hardened.

34. The method recited in claim 33, wherein, in applying suitable heat, the underfill material is completely hardened.

35. The component package recited in claim 22, further fabricated by applying suitable heat to melt solder situated between the terminals and pads, which when cooled results in an electrical and mechanical connection between corresponding terminals and pads.

36. The electronic assembly recited in claim 27, further fabricated by applying suitable heat to melt solder situated between the terminals and pads, which when cooled results in an electrical and mechanical connection between corresponding terminals and pads.

37. An electronic assembly comprising:

at least one integrated circuit (IC) package having a plurality of terminals;

a substrate having a plurality of pads coupled to the plurality of terminals via a corresponding plurality of connections;

a hardened underfill encapsulating the terminals, pads, and connections; and

a plurality of particles in the underfill, except that substantially no particles are in the connections, wherein the particles are of such size and composition as to potentially inhibit suitable connections between corresponding terminals and pads if particles are in the connections.

38. The electronic assembly recited in claim 37, wherein the particles have a size in the range of 0.05 microns to 40 microns.

39. The electronic assembly recited in claim 37, wherein the particles are substantially spherical.

40. The electronic assembly recited in claim 37, wherein the particles comprise material selected from the group consisting of silica, silicon oxide, silicon dioxide, silicon nitride, aluminum oxide, aluminum nitride, ceramic oxide, and ceramic nitride.

41. A method comprising:

depositing a no-flow underfill material over a plurality of pads in a component-mounting area of a substrate, the underfill material comprising a fluxing filler material containing particles;

placing a component on the component-mounting area, such that terminals of the component are aligned with corresponding pads and substantially enveloped in the underfill material, the particles potentially inhibiting a suitable connection between corresponding terminals and pads unless the particles are substantially removed;

applying suitable heat for the fluxing filler material to clean surfaces of the terminals and pads to be subsequently joined by solder; and

applying suitable pressure to cause the terminals to physically contact the pads and to remove substantially all potentially inhibiting particles from between corresponding terminals and pads.

42. The method recited in claim 41, wherein the recited operations are performed in a different order.

43. The method recited in claim 41 wherein, before placing the component, heat is applied to the component to raise its temperature to soaking temperature.

44. The method recited in claim 41 and further comprising:

applying suitable heat to melt solder situated between the terminals and pads, which when cooled results in a suitable electrical and mechanical connection between corresponding terminals and pads.

45. The method recited in claim 41 and further comprising:

applying suitable heat to melt solder situated between the terminals and pads, which when cooled results in a pre-attachment between corresponding terminals and pads.